

# Claims

- [c1] 1. A method for determining an idle torque for an engine in a vehicle, the idle torque for the engine being at least partly based on an engine torque level below which engine misfires will occur, the vehicle including an electric machine operable to provide torque to the engine, the method comprising:
- commanding the engine to operate in an idle state, including providing a torque command to the engine;
  - determining an output torque of the engine while the engine is in the idle state;
  - determining a torque offset defined as a difference between the torque command and the determined engine output torque; and
  - determining the idle torque for the engine based at least in part on the torque offset.
- [c2] 2. The method of claim 1, wherein determining the idle torque for the engine includes mathematically combining the torque offset with a stored torque offset, and determining the idle torque based at least in part on the mathematical combination of the offsets.
- [c3] 3. The method of claim 1, the vehicle further including

an air conditioning system compressor and an emissions system carbon canister, the method further comprising: prohibiting operation of the compressor while the output torque of the engine is being determined; and prohibiting purge of the carbon canister while the output torque of the engine is being determined.

- [c4] 4. The method of claim 1, further comprising:  
determining whether the torque offset is within a predetermined torque offset range for a predetermined period of time; and  
waiting to determine the idle torque for the engine until the torque offset is within the predetermined torque offset range for the predetermined period of time.
- [c5] 5. The method of claim 1, further comprising:  
prohibiting engine shutdown prior to commanding the engine to operate in the idle state.
- [c6] 6. The method of claim 1, wherein commanding the engine to operate in the idle state further includes providing a speed command to the engine.
- [c7] 7. The method of claim 1, wherein the determined engine output torque is at least partly based on an output torque of the electric machine.
- [c8] 8. A method for determining an idle torque for an engine

in a vehicle, the vehicle including an electric machine operable to provide torque to the engine, and an energy storage device capable of providing energy to operate the electric machine, the method comprising:

determining whether at least one initial condition is met;

and

initiating an idle torque adaption algorithm when the at least one initial condition is met, the idle torque adaption algorithm including,

- a) commanding the engine to operate in an idle state, including providing a torque command to the engine,
- b) determining an output torque of the engine while the engine is in the idle state,
- c) determining a torque offset defined as a difference between the torque command and the determined engine output torque,
- d) determining whether at least one secondary condition is met,
- e) determining the idle torque for the engine based at least in part on the torque offset when the at least one secondary condition is met, and
- f) restarting the idle torque adaption algorithm when the at least one secondary condition is not met.

[c9] 9. The method of claim 8, wherein the at least one initial condition is chosen from a first set of conditions, includ-

ing a vehicle transmission gear being in a drive gear or a low gear, a discharge power limit for the energy storage device being greater than a predetermined discharge power limit value, a charge power limit for the energy storage device being greater than a predetermined charge power limit value, and an engine coolant temperature being within a predetermined engine coolant temperature range.

[c10] 10. The method of claim 8, wherein the at least one secondary condition is chosen from a second set of conditions, including a vehicle speed being less than a predetermined vehicle speed, an accelerator pedal being disengaged, a brake pedal being engaged, an engine power command being less than a predetermined engine power command, an engine speed being less than a predetermined engine speed, and a time since initiating the idle torque adaption algorithm being less than a predetermined time.

[c11] 11. The method of claim 8, further comprising:  
counting the number of times the idle torque adaption algorithm is restarted;  
prohibiting engine shutdown when the number of times the idle torque adaption algorithm is restarted is at or below a predetermined number; and  
allowing engine shutdown when the number of times the

idle torque adaption algorithm is restarted is above the predetermined number.

- [c12] 12. The method of claim 8, wherein determining the idle torque for the engine includes mathematically combining the torque offset with a stored torque offset, and determining the idle torque based at least in part on the mathematical combination of offsets.
- [c13] 13. The method of claim 8, the vehicle further including an air conditioning system compressor and an emissions system carbon canister, the method further comprising: prohibiting operation of the compressor while the output torque of the engine is being determined; and prohibiting purge of the carbon canister while the output torque of the engine is being determined.
- [c14] 14. The method of claim 8, further comprising: determining whether the torque offset is within a predetermined torque offset range for a predetermined period of time; and waiting to determine the idle torque for the engine until the torque offset is within the predetermined torque offset range for the predetermined period of time.
- [c15] 15. The method of claim 8, further comprising: prohibiting engine shutdown prior to commanding the

engine to operate in the idle state.

[c16] 16. The method of claim 8, wherein commanding the engine to operate in the idle state further includes providing a speed command to the engine.

[c17] 17. The method of claim 8, wherein the determined engine output torque is at least partly based on an output torque of the electric machine.

[c18] 18. A vehicle comprising:  
an engine;  
an electric machine operable to provide a torque to the engine; and  
at least one controller configured to command the engine to operate in an idle state by at least providing a torque command to the engine, the at least one controller being further configured to determine an output torque of the engine while the engine is in the idle state, determine a torque offset defined as a difference between the torque command and the determined engine output torque, and determine the idle torque for the engine based at least in part on the torque offset.

[c19] 19. The vehicle of claim 18, wherein the at least one controller is further configured to mathematically combine the torque offset with a stored torque offset, and to

determine the idle torque based at least in part on the mathematical combination of the offsets.

- [c20] 20. The vehicle of claim 18, further comprising:  
an air conditioning system including a compressor; and  
an emissions system including a carbon canister, and  
wherein, the at least one controller is further configured to prohibit operation of the compressor and prohibit purge of the carbon canister while the output torque of the engine is being determined.
- [c21] 21. The vehicle of claim 18, wherein the at least one controller is further configured to determine whether the torque offset is within a predetermined torque offset range for a predetermined period of time, and to wait to determine the idle torque for the engine until the torque offset is within the predetermined torque offset range for the predetermined period of time.
- [c22] 22. The vehicle of claim 18, wherein the controller is further configured to prohibit engine shutdown prior to commanding the engine to operate in the idle state.
- [c23] 23. The vehicle of claim 18, wherein the controller is configured to determine the engine output torque based at least in part on an output torque of the electric machine.

